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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
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ART UNIT	PAPER NUMBER
2192	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/784,753	GUSTAFSON ET AL.	
	Examiner	Art Unit	
	Zheng Wei	2192	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 February 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. This office action is in response to the application filed on 02/23/2004.

2. Claims 1-30 are pending and have been examined.

Oath/Declaration

3. The Office acknowledges receipt of a properly signed oath/declaration filed on February 23, 2004.

Priority

4. The priority date considered for this application is February 23, 2004.

Drawings

5. The drawings filed on February 23, 2004 are accepted by the Examiner.

Claim Objections

6. Claims 26 and 29 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

Claim 26:

Claim 26 should depend on claim 18 instead of claim 16, as claim 16 is a method claim and claim 18 is a system.

Claim 29:

Claim 29 should depend on claim 28 instead of claim 23. Because there is no definition of term "accuracy threshold" claimed in claim 23.

7. Claims 1, 6 and 28 are objected to because of the following informalities:

Claim 1: "a floating point variable" should be changed to – a floating-point variable— .

Claim 6:The word "and" in claim 6 "the error variable comprises an upper limit interval variable and a lower limit interval variable" should be changed to –or--. Because applicant defines only "an error variable" in claim 3. Therefore, the error variable can only comprises either an upper limit interval variable or a lower limit interval variable.

Claim 28: The term "accuracy threshold hold" is a typo. It should be changed to – accuracy threshold --

Appropriate correction is required.

Claim Rejections - 35 USC § 112

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claim 28 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 28 recites the limitation "the accuracy threshold" in page 22, line 2. There is insufficient antecedent basis for this limitation in the claim.

10. The term "accuracy-aware tracking structure" in claims 1-30 is not clear. Because it can be also interpreted as data, data structure or program code...For the purpose of compact prosecution, the Examiner treats “accuracy-aware tracking structure” as -- a tracking program/code --.

11. The term "half unit in last place variable" in claims 4, 5, 21, 22, 28 and 29 is a relative term which renders the claim indefinite. The term "half unit in last place variable" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. For the purpose of compact prosecution, the Examiner treats “half unit in last place variable” as a general variable of program language.

Claim Rejections - 35 USC § 101

12. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

13. Claims 18-29 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

Claims 18: Claim 18 claims a system, which comprises a source code, a preprocessor, a runtime utility and a runtime environment. However, All of these components are software components (see for example, Fig.1 and related text). Such claimed software module/programs are software program listings per se and they do not define any structural and functional interrelationships between the computer program and other claimed elements of a computer, which permit the computer program's functionality to be realized. Therefore, claim 18 is not statutory. See MPEP 2106.01(I)

Claims 19-29: Claims 19-29 are dependent claims of claim 18. These claims all fail to remedy the 35 USC 101 nonstatutory problem of claim 18. Therefore they are rejected for the same reason.

--These rejections can be overcome by adding computer hardware components e.g., memory, and processor into the claims that permit the computer program's functionality to be realized.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

15. Claims 1-11, 13-27, 29 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kolawa (US 6,085,029) in view of Aberth (Aberth et al., Precise Computation Using Range Arithmetic, via C++)

Claim 1:

Kolawa discloses a method for accuracy-aware analysis (error-checking) of a program, comprising:

- obtaining source code for the program (see for example, Fig.3, item 31 "Provide Source Code" and item 32 "Source Code File" and related text);
- instrumenting the source code to obtain instrumented source code (see for example, Fig.3, item 37 "Instrumentation', item 38 "Instrumented Parse Tree" and related text; also see Fig.5c, step 75, "Insert Automatic Test Case Generation Instrumentation");

- compiling to instrumented source code to obtain instrumented compiled code (see for example, Fig.3, item 39, "Code Generation" and item 40, "Object Code File"; also see Fig.1, step 11, "Compilation Process" and related text); and
- executing the instrumented compiled code, wherein executing the instrumented compiled code (see for example, Fig.1, step 14, "Execution Process" and related text)

but does not explicitly discloses the source code comprises floating-point variable and using the accuracy-aware tracking structure to track an operation on the floating-point variable. However, Aberth in the same analogous art of accuracy-aware analysis (precise computation) discloses a method using range arithmetic to make the precision dynamically adjustable, and permit error monitoring. (see for example, p.482, section 2, "Range Arithmetic", lines 2-3"). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use Aberth's method to instrument in Kolawa's invention to detect program accuracy (see for example, p.481, abstract section, lines 1-2, "for programming tasks requiring assured accuracy"). One would have been motivated to do so for automatically and dynamic debugging software program as suggested by Kolawa (see for example, lines 27-34)

Claim 2:

Kolawa and Aberth disclose the method of claim 1, Aberth further discloses the

method comprising: generating an accuracy-aware analysis report using the accuracy-aware tracking structure (see for example, p.488, example code with output statement "cout<<" and related text).

Claim 3:

Kolawa and Aberth disclose the method of claim 2, Aberth further discloses wherein the accuracy-aware analysis report includes at least one tracking variable associated with the floating-point variable selected from the group consisting of an error variable, a scaled mantissa digits variable, a renormalization variable, a left digit destruction variable, and an operations variable (see for example, p.488, example code with output statement "cout<< 'f='" and related text; "f" is considered as output to indicate precision test failed).

Claims 4 and 5:

Kolawa and Aberth disclose the method of claim 3, Aberth further discloses wherein a value of the half unit in last place variable (treated as general error variable for the reason above under 35 U.S.C. 112, second paragraph rejection) is determined using information obtained during renormalization (see for example, p.488, example code for calculating the value of floating-point variable "f").

Claim 6:

Kolawa and Aberth disclose the method of claim 3, Aberth further discloses wherein the error variable comprises an upper limit interval variable and [or] a lower limit interval variable (see for example, p.488, lines 1-2, "The correct evaluation of f to the 15 decimal places of (3) is routine using range arithmetic"; also see example C++ code).

Claims 7 and 8:

Kolawa and Aberth disclose the method of claim 3, Aberth further discloses wherein ranged variables comprise at least one selected from the group consisting of a multiplication variable, a division variable, and a square root variable (see for example, p.486, section 4, Range Arithmetic in C++, lines 1-2, "We define the class rvar for ranged variables, with the four rational operation +, -, *, /, ...".), but does not explicitly discloses an operations variable and a renomalization variable for tracking different operations. However, it is well known in the computer art that the variables in Aberth's disclosure could be used to track different operations according programmer's implementation. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use different variables (operations variable and renomalization variable) to track different operation, e.q. +, _, *, /...)

Claim 9:

Kolawa and Aberth disclose the method of claim 1, Aberth further discloses wherein executing the compiled instrumented code comprises:

- performing the operation on the floating-point variable to obtain a result (see for example, p.488, example code for calculating the value of floating-point variable "f");
- incrementing a tracking variable corresponding to the operation associated with the floating-point variable (see for example, p.488, example code for adding precision, "add_precision()");
- determining whether the result is exact using a scaled mantissa of the result (see for example, p.488, example code for determining exact, "test()"); and
- quantifying error associated with the result if the result is not exact (see for example, p.488, example code for quantifying error, "if (test failure) add_precision()").

Claim 10:

Kolawa and Aberth disclose the method of claim 9, Aberth further discloses the method comprising:

updating error variable using data obtained from quantifying the error associated with the result, if the result is not exact (see for example, p.488, example code for quantifying error, "if (test_failure) add_precision()").

Claim 11:

Kolawa and Aberth disclose the method of claim 9, Aberth further discloses the method comprising: determining whether the result exceeds an accuracy threshold if the result is not exact (see for example, p.488, example code for setting threshold and determining accuracy, "set_precision(20)" and "test(f,1,15) and related text) .

Claim 13:

Kolawa and Aberth disclose the method of claim 11, Aberth further discloses he method, wherein the accuracy threshold comprises at least one selected from the group consisting of a relative error threshold, an absolute error threshold, and a comparison test (see for example, p.488, "Note the initial setting of precision at 20 decimal digits...").

Claim 14:

Kolawa and Aberth disclose the method of claim 1, Aberth further discloses the method comprising: setting an accuracy threshold for the program exact (see for example, p.488, example code for setting threshold, "set_precision(20)" and related text).

Claims 15-16:

Claims 15-16 use the same method as described in claim 1 above to update/modify instrumentation source code following the same steps, wherein all claimed limitation functions have been addressed and/or set forth above. Therefore, they also would have been obvious by Kolawa and Aberth.

Claim 17:

Kolawa and Aberth disclose the method of claim 1, Aberth further discloses wherein the floating-point variable is double type (see for example, p.487, Fig.1, "double floating point arithmetic" and related text)

Claims 18-27 and 29:

Claims 18-27 and 29 are system version for performing the claimed method as in claims 1-11 and 13-17 addressed above, wherein all claimed limitation functions have been addressed and/or set forth above and certainly a computer system would need to run and/or practice such function steps disclosed by reference above. Thus, they also would have been obvious.

Claim 30:

Claim 30 is another system version for performing the claimed method as in claim 1 addressed above, wherein all claimed limitation functions have been addressed and/or set forth above and certainly a computer system would need to

run and/or practice such function steps disclosed by reference above. Thus, it is also would have been obvious.

16. Claims 12 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kolawa (US 6,085,029) in view of Aberth (Aberth et al., Precise Computation Using Range Arithmetic, via C++) in further view of Kahan (Prof. W. Kahan, IEEE Standard &54 for Binary Floating-Point Arithmetic)

Claim 12:

Kolawa and Aberth disclose the method of claim 11, but neither of them discloses wherein execution of the compiled instrumented code halts if the accuracy threshold hold is exceeded. However, Kahan in the same analogous art of IEEE Standard &54 for Binary Floating-Point Arithmetic discloses an exception INEXACT trap. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to implement the feature to halt the execution if accuracy threshold hold is exceeded. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to do so to implement floating-point related feature according the standard specification. (see for example, p.18, section Exception: INEXACT and related description)

Claim 28:

Claim 28 is a system version for performing the claimed method as in claim 12 addressed above, wherein all claimed limitation functions have been addressed and/or set forth above and certainly a computer system would need to run and/or practice such function steps disclosed by reference above. Thus, it is also would have been obvious.

Conclusion

17. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- IEEE 754 floating-point test software, discloses collection of test programs for examining the behavior of IEEE 754 floating-point arithmetic;
- Stolfi et al., Self-Validated Numerical Methods and Applications, discloses approximate computation using interval arithmetic and offine arithmetic with guaranteed error bounds.
- Daniel Oldman (US 6,769,115) discloses an adaptive interface for a software development environment of early detecting of problems.
- Chilimbi et al., (US 2005/0091645) discloses a method of adaptive instrumentation runtime monitoring and analysis.

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Zheng Wei whose telephone number is (571)

270-1059 and Fax number is (571) 270-2059. The examiner can normally be reached on Monday-Thursday 8:00-15:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on (571) 272-3695. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Any inquiry of a general nature of relating to the status of this application or proceeding should be directed to the TC 2100 Group receptionist whose telephone number is 571- 272-1000.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

ZW

TUAN DAM
SUPERVISORY PATENT EXAMINER